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A device for emptying hot particle material from a chamber into a transport container

The invention relates to a device for emptying hot particle material from a chamber into a transport container of the type revealed in the preamble to claim 1.

It is in practice already known that the transport container, carried by an overhead crane in an industrial hall, has a first pipe such as a telescopic pipe that can be inserted into the particle material in the chamber, and a second pipe that is connected to a vacuum source via a powder separator, wherein the first and second pipes communicate with the upper part of the container and are spaced from each other, wherein the container has an outlet in its lower, downwardly narrowing part, said outlet being provided with a valve, for evacuation of particle material deposited in the container, and wherein a vertical chute which surrounds the outlet valve and extends downwardly therefrom, has an evacuation pipe connected to a negative pressure source for withdrawal of dust from the shaft when the container is being emptied.

A device of the type indicated is used, for instance, in plants producing graphite electrodes by a corresponding green electron being lowered into a chamber filled with particle material such as coal dust heated to high temperature. To enable removal of the finished electrode from the chamber, the hot coal particles must first be removed, after which the hot coal particles can be re-used in a similar chamber into which a green electrode has been inserted. Normally the hot particle material must be cooled before it can be introduced into a chamber for embedding a green electrode.

One object of the invention is to provide a device which enables the powder material to be cooled in an efficient manner. Another object of the invention is to design the device so that the powder material can easily be caused to flow out through the outlet valve of the container.

Yet another object of the invention is to provide a device that offers simple and efficient removal of polluted air from the vertical chute when the container is being emptied through the chute.

These objects are achieved by means of the invention.

The invention is defined in the appended claim 1.

Embodiments of the device are specified in the appended dependent claims.

The invention is illustrated schematically in Figure 1. Figure 2 shows schematically a section through the transport container of the device.

Figure 1 illustrates an overhead crane 1 carrying a transport container 2.

The container 2 may be considered closed, a suction pipe 3 communicating with the upper part of the container 2 and having, for instance, a telescopic end section 31 which can be lowered into a chamber 4. Said chamber 4 constitutes, for instance, a graphitization furnace for graphite electrode blanks. A green graphite electrode is inserted in such a chamber and packed in particle material, e.g. coal, after which the particles in the chamber 4 are heated to high temperature.

When the product is ready the pipe section 31 is lowered into the particles in the chamber 4, the particle material then being drawn up through the pipe and deposited in the container 2 with the aid of a transport air-flow generated by a suction fan 5 which, via a suction pipe 6 communicates with the top of the container 2 via a precipitator 7 that separates any dust remaining in the air-flow to the fan 5.

The container 2 has a bottom outlet with a shut-off valve 10. A vertical chute 20 adjoins the bottom outlet of the container to surround and screen off a flow of particle material released through the outlet of the container 2 to a chamber 4′ which is to be filled with particle material from the container 2 when the container 2 has been moved to the location of the chamber 4′ by the overhead crane 1.

It can be seen in Figure 2 that the pipes 3, 6 communicate with the upper part 21 of the container 2. The pipes 3 and 6 are suitably located in diametrically opposite areas of the container 2. In the main part of the container 2 below the precipitator 21 is a heat exchanger 40 through which a cooling fluid, suitably air, flows.

The heat exchanger 40 is shown in the form of parallel, plate-shaped, vertically oriented elements 41 through which the coolant flows. The air supply pipe 60 is shown extending generally horizontally through the interior of the container at several levels. Inside the container 2 the pipe 60 is provided with a plurality of air outflow openings spaced from each other and opening into the particle material between the heat-exchanger plates 41. The pipe 60 is supplied with compressed air at its inlet end 67

outside the container 2. Downstream of the end 67 is a valve 61 which is opened and closed, controlled by software 63.

The lower part of the container has a conically narrowing section 17 leading to the container outlet 11 provided with a valve 10. A pipe 22 extends through the container section 70 and has an inlet end 27 through which ambient air is drawn in. The pipe 22 has an outlet part 28 opening into the upper part 21 of the container 2. In the section of the pipe 22 extending through the container part 17 is an ejector pump 29 by means of which powder material is drawn into the air-flow of the pipe 22 and carried to the upper part 21 of the container by means of the negative pressure generated by the fan 5. Several such pipes 22 are shown extending through the container part 17. One pipe 22′ is connected by means of a conduit 70, e.g. a hose, to the inside of the vertical chute 20. The latter may be in the form of a bellows, so that the ambient air is conducted via the chute 20 and hose 70 to the pipe 22′. Thus the dust generated inside the vertical shaft 20 when material flows through the valve 10 is returned to the upper part of the container 2.

The device shown in Figures 1 and 2 functions in that hot powder material from the chamber 4 is drawn up through the pipe 3 with the aid of an air-flow drawn by the fan 5 through the pipe 6 via the precipitator through the container 2 and pipe 3. A considerable amount of the powder material, e.g. 90 per cent, then falls down into the lower part of the container while the rest is separated off and collected in the precipitator for re-use in a separate procedure.

The material deposited in the container is cooled by the elements 41 of the heat exchanger and set in motion by the air flowing out through the

openings 64 in the compressed air supply pipe 60. The particle material that moves to the lower area of the container is drawn into the pipes 22 and returned to the upper part where, due to the force of gravity, it moves down in cooling contact with the cooling surfaces 40 of the heat exchanger. When the container 2 has been filled with material, and after a predetermined storage period for container and material, the container 2 is placed with its vertical chute 20 directed towards a chamber 4′ to which the powder material shall be transferred. During emptying the suction fan 5 remains in operation, the inlet valve 32 of the pipe 3 is closed and the bottom valve 10 opened. One or more air induction pipes 80 with valves 81 are also connected to the lowermost part of the container 2. The valves 81, which are otherwise closed, are now opened so that air is drawn into the particle material in the lower part of the container. The total effect is that large quantities of air flow through the mass of powder material in the container 2 and are conducted through the pipe 6. The cooling effect is thus efficient while, at the same time, the negative pressure in the lower part of the container is equalized. The pre-requisite is thus established for the powder material to be able to flow down and out through the outlet 11 and valve 10 in the chute 20. Suction of dust through the hose 70 and pipe 22′ also has a cooling effect on the powder material flowing down through the chute 20. The material has a temperature of, say, 600°C at the inlet to the container 2 and the temperature in the outlet pipe may be around 250°C. The temperature of the material when it is emptied through the vertical chute 20 may be around 60°C.

Thanks to the invention the powder material collected in the container 2 can be efficiently cooled before being re-used or withdrawn from the container 2.

Thanks to the invention there is no need to temporarily remove the powder material from the container 2 for cooling before the powder is returned to the container 2 for transport to a site for use.

Figure 2 also shows a pipe 90 extending transversely through the hollow heat-exchanger plates 41 and communicating with the interior thereof. The pipes 90 have outflow openings 92 between the heat-exchanger bodies 41 so that air flows out through the openings 92 and reduces the negative pressure existing in the powder material between the heat-exchanger bodies 41.

If the heat-exchanger bodies 41 are plate-shaped and have walls consisting of relatively thin plates, the effect is achieved that air flowing out from the interior of the heat-exchanger bodies 41 into the spaces between the bodies 41 limits the negative pressure in these spaces, thereby limiting the tendency of adjacent plate walls of heat-exchanger bodies 41 in proximity of each other to be drawn towards each other by the pressure different over each plate. Furthermore, the air-flow out through the openings 92 causes the powder material to become fluidized so that it can flow down through the outlet 11 when the valve 10 is opened.

The ends 91 of the pipe 90 may also be open towards the surrounding atmosphere outside the walls of the container 2 to permit air to be drawn into the pipe 90 and out through the openings 92.

Naturally several such pipes 90 with openings 92, 91 may be arranged beside each other and at several levels in the container 2.